Exhibit 2

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF NEW YORK

VILLAGE OF STILLWATER,
TOWN OF STILLWATER,
TOWN OF WATERFORD,
WATER COMMISSIONERS OF THE
TOWN OF WATERFORD,
VILLAGE OF WATERFORD,
TOWN OF HALFMOON and
COUNTY OF SARATOGA,

Plaintiffs,

v.

GENERAL ELECTRIC COMPANY,

Defendant.

Case No. 1:09-cv-0228,
DNH-DRH,
consolidated with
Case No. 1:11-cv-006

EXPERT REBUTTAL REPORT

OF

KIRK WYE BROWN, PH.D.

(Signature)

February 14, 2014

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Appendices

Executive Summary

I have been asked by counsel to review the site information and associated documents provided by the Defendants concerning the Hudson River Superfund Site and the associated widespread release and transport of polychlorobiphenyl ("PCB") and PCB containing waste oils generated by the General Electric Company ("GE") into the Upper Hudson River. Specifically, I have been asked to review the Defendant's expert reports, provide responses to the opinions provided by the defendant's experts, and review the data that has been made available to me since my September 20, 2013 expert report. I have reviewed the new information and reports, gathered independently and provided by counsel and the defendants. In this rebuttal report, I reaffirm my opinions put forth in my previous report and offer responses to the opinions of Neil Shifrin, John Connolly, Stephen Johnson, and Scott Warner.

1.0 Introduction

I have been retained by counsel to provide my professional opinions concerning the Hudson River Superfund Site; the communities of Stillwater, Waterford, and Halfmoon; and the release of PCBs and PCB containing waste oils generated by the General Electric Company to the Hudson River. Specifically, I was asked to review the information provided by the Defendants and their experts that has become available since my expert report dated September 20, 2013. I have reviewed the reports and new information, gathered independently, provided by counsel and the Defendants, and offer my professional opinions in this report. I reserve the right to update my opinions and analysis as other witnesses, including opposing experts, provide additional information for my review.

1.1 Background/Qualifications

From 1970 through 2001, I was employed as a Professor of Soil and Crop Sciences in the Soil and Crop Sciences Department, Texas A&M University, College Station, Texas. I currently serve as *Professor Emeritus* in the Soil and Crop Sciences Department, Texas A&M University, College Station, Texas. In 1990, I received a joint appointment to the faculty in Toxicology at Texas A&M University, where I supervised the research of masters degree and doctoral candidates in the field of toxicology. My educational background includes a Bachelor of Science degree in Agronomy from Delaware Valley College (1962), Masters of Science degree in Agronomy/Plant Physiology from Cornell University (1964), and Doctor of Philosophy degree from University of Nebraska (1969). My résumé was submitted as Appendix 1 of my September 20, 2013 expert report. It includes my complete list of my publications.

While a member of the faculty at Texas A&M University, I conducted extensive research including numerous research projects for the U.S. Environmental Protection Agency and the National Institute of Health ("NIH") on the fate and transport of contaminants, including pathways of exposure and toxicity of hazardous substances to receptors in the environment. As a result of these research efforts, I have authored or co-authored over 190 peer-reviewed, scientific publications, including numerous articles dealing with the disposal and treatment of waste materials, including Resource Conservation and Recovery Act ("RCRA") hazardous wastes and

Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") hazardous substances contained therein and the problems arising therefrom. Additionally, I have authored or co-authored over 35 publications which deal with risk assessment or toxicity of hazardous substances in the environment.

I have conducted research in a national center funded by the EPA to study the fate of hazardous substances in the environment. During my tenure at Texas A&M University, I taught courses in Soil Physics which included topics on the movement of air, water, and other fluids in the soil, and a graduate course on the land disposal of wastes, which included consideration of the principles and practices applicable to the fate, mobility, and clean-up of contaminated sites. Students in these classes included engineers, soil scientists, chemists, and geologists. I have served on hundreds of advanced degree committees in these and related disciplines.

I have served on technical advisory panels to the EPA, committees of the Office of Technical Assessment, and the National Academy of Science. Significant reports resulting from these committee assignments include, Groundwater and Soil Cleanup, Improving Management of Persistent Contaminants (1999); Ranking Hazardous Waste Sites (1994); Coming Clean, Superfund Problems Can be Solved (1989); and Superfund Strategy (1985). I was the primary author of a 1983 publication for the EPA entitled Hazardous Waste Land Treatment. This publication specifically addressed the treatment of hazardous wastes from industrial waste streams to mitigate risk during treatment and eliminate risk to potential receptors.

In 1981, I was appointed to the EPA Land Treatment Task Force where I served from 1981 through 1985. As part of my assignment with the Task Force, I evaluated the alternatives for land disposal of wastes and the risk associated with the disposal alternatives. While a member of this Task Force, I testified before the U.S. House of Representatives - Science and Technology Committee in November 1982 on the adequacy of EPA's liquid management system to protect groundwater at hazardous waste landfills, which lead to the passage of the Hazardous and Solid Wastes Amendments of 1984 under the Resource Conservation and Recovery Act.

In 1983 and 1984, I was a member of the Advisory Panel to U.S. Congressional Office of Technology Assessment. This panel was tasked with determining the effectiveness of current EPA programs to clean up uncontrolled hazardous waste sites. As part of my assignment with this committee, I reviewed and evaluated the toxicity and imposed risk to receptors due to

hazardous substances and provided recommendations for improving the efficiency of EPA programs to mitigate risk at uncontrolled hazardous waste sites.

In 1984, I was a member of the Office of Water Regulations and Standards Committee on Municipal Sludge Landfilling, which was formed to advise EPA on the pollutants which should be regulated for disposal and the methods or procedures to be used for regulating such pollutants. As part of my work for this committee, I assessed the hazards and risk associated with the hazardous substances contained in municipal sewage sludge and provided recommendations for regulation of metals in sewage sludge based on the degree of risk presented by exposure to these metals.

From 1987 through 1995, I was a member of the Advisory Panel to U.S. Congressional Office of Technology Assessment which was tasked with assessing the effectiveness of the EPA in identifying, prioritizing and cleaning up hazardous waste sites. As part of my work for this committee, I evaluated the impacts of exposure from different media and the effectiveness of available technologies to mitigate exposure and risk from hazardous waste sites.

From 1991 through 1994, I served on the National Academy of Sciences Committee on Remedial Action Priorities for Hazardous Waste Sites, where I evaluated the role of risk assessment and mitigation of risk in the decision process for remedial action.

From 1995 through 1998, I served on the National Academy of Sciences, National Research Council Committee on Environmental Technologies Subcommittee on Landfills. As part of my assignment to this committee, I evaluated the risk due to contaminants in soil and groundwater and recommended strategies for the management and control of recalcitrant wastes for the reduction of risk due to these persistent contaminants.

In addition, I have served on numerous EPA review panels addressing toxicity and risk including the following, among others:

- EPA Panel to Review the Acceptability of Landfill Disposal of Sewage Sludge (1984);
- EPA Panel to Write a Protocol for Mutagenicity Sample Preparation (1984);
- EPA Hazardous Waste Center Review Panel (1988); and
- EPA Review for Risk Assessment for Petroleum Industry Hazardous Waste Listing Determination (1995).

Additionally, I provided technical review as a member of peer review panels for the United States Department of Health and Human Services, Public Health Services for review of

toxicological profiles for the Agency for Toxic Substances and Disease Registry ("ATSDR") from 1990 through 2000.

I am personally familiar with the definition of "hazardous substance" as defined in § 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act and under the statutes and regulations incorporated by reference into that section. A hazardous substance under CERCLA is defined in 42 U.S.C. § 9601 (14), invoking the EPA designations under 42 U.S.C. § 3001 and 9602, among other statutes. Included in the definition of a CERCLA hazardous substance are certain hazardous wastes which are either listed in 40 C.F.R § 261, Subpart D or have certain identified characteristics as described in 40 C.F.R. § 261, Subpart C. Likewise, I am familiar with the regulations defined in 40 CFR § 761 and the requirements specified for the disposal of PCBs as hazardous wastes contained in Subpart G of that chapter.

I have studied and am familiar with industrial, commercial, and residential waste, and the landfills that eventually contain such waste. I have researched the risks associated with leachate from landfills containing these wastes. I have also investigated the fate and behavior of organic compounds and metals found in leachate from landfills and the resulting impacts on the underlying groundwater. I have reviewed numerous remedial plans and proposed remedies pertaining to landfills containing industrial, commercial, and residential wastes.

I have studied and am familiar with the fate and transport of non-aqueous phase liquids ("NAPL") including dense non-aqueous phase liquids in the environment. I have conducted extensive research on the movement of NAPLs through clay soils for EPA and substantial research on the partitioning of organic constituents between aqueous and non-aqueous phase liquids. I have studied the partitioning of PCBs into non-aqueous phase liquids associated with the Delaware River at the Metal Bank of America Superfund Site in addition to the fate and transport of PCB containing oils in the mud flats and riverbanks of the Delaware River.

Further, I have designed and implemented numerous remedial response actions under RCRA. Many of these response actions were implemented consistent with the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"), including remedial projects for Exxon, Chevron, Koch Industries, Inc. and Marathon Oil.

I have been a consultant in the field of environmental science and engineering for the past 33 years. I founded K. W. Brown and Associates, Inc., and served as President from 1980 until

1991. I was employed as a Principal Consultant with K. W. Brown Environmental Services from 1991 until 1999 and with SI Group, LP from 2000 through 2008. In March 2009, I joined the firm of ThermoTech Intl. (TTI) and was employed as a Principal Consultant through April 2011. Since that time, I have been employed as an independent consultant.

Through these years of consulting, I was employed by numerous private and public clients. My expertise has been utilized for site assessments, data review and interpretation, waste management activities, the study of fate and transport of contaminants in the environment, the movement of contaminants in groundwater and surface water, the design and implementation of remedial actions for recalcitrant organic compounds, and other related environmental matters. I have also reviewed and interpreted a large quantity of analytical data for soils and groundwater, as well as borings logs, field logs, technical reports, and other information related to the environmental conditions of a site.

As a consultant, I have evaluated or analyzed numerous waste disposal and landfill sites including the following: Laurel Park Landfill, Beacon Heights Landfill, Lone Pine Landfill, Ft. Bend County Landfill, Oak Grove Landfill, East Bethel Landfill, Dickson County Landfill, and Sinton Landfill, among others. In addition, I have also worked on the following Superfund sites: Hardage Criner, Love Canal Landfill, Lowrey Landfill, Montana Pole, National Gypsum, Riley Tar, Sharon Steel, Helen Kramer Landfill, Sikes' Pits, Metal Bank of America, Tar Creek, and the West Dallas Lead Site.

1.2 Prior Expert Testimony

A complete list of cases in which I have rendered opinions is presented in Appendix 2 of my expert report previously submitted, dated September 20, 2013.

1.3 Compensation

I am being compensated at my customary rate for work in this case. My hourly rate of compensation is $300 per hour for non-testimony time and $350 per hour for testimony time.

1.4 Exhibits

I may use as exhibits any document contained or referred to in this report, or supplements to this report, including but not limited to the appendices; any document needed as foundation

for or illustration of my testimony; any document listed as an exhibit or provided in discovery by Defendants or any other party; any document considered by any of the Defendant's or any other party's experts; or any document needed to respond to or to rebut testimony on behalf of Defendants or any other party. I reserve the right to provide lists of exhibits as permitted by the Federal Rules of Civil Procedure and the Scheduling Orders in this case.

1.5 Reservation of Rights

I reserve the right to supplement or modify opinions expressed herein upon which I expect to testify, to add to or modify the bases and reasons for my opinions and supplement the exhibits that I may use at trial for any of the following reasons: (1) to respond to expert reports, including but not limited to rebuttal reports, conducted for Defendants or for any other party; (2) to respond to new information; (3) to respond to information obtained in discovery, including but not limited to depositions and interviews; and (4) as permitted by Rule 26 Fed. R. Civ. P.

2.0 Data or Other Information Considered

This report was developed as a result of discovery of data to which I have been provided access. The opinions I have formed in this case are based on my education and experience listed in Section 1.0, as well as the information cited for this report in Appendix 1.

3.0 Background

In my previous report, I presented the following opinions based on the site information and the heretofore understanding of dredging as the implemented remedial technology.

1. Polychlorobiphenyls, due to their chemical structure have a very long lifetime in the environment. Further, the International Agency for Research on Cancer has classified PCBs as human carcinogens. It is therefore my opinion, that any PCBs remaining in the river environment will impact all forms of life in the river ecosystem, including the inhabitants that live along the river, and those in the municipalities that rely on the Hudson River below Fort Edward as a source of water.
2. GE has failed to provide a mass balance calculation of the amount of PCBs that were released to the environment. Furthermore, the total mass of PCBs entering and continuing to enter the river has not been determined, and all of the potential sinks for PCBs along the river have yet to be identified. Additionally, the total mass of PCBs in each of the components of the river is unknown. Dredging has demonstrated higher mass loading and concentrations of PCBs in the water column downstream, however, the locations of redeposited PCBs has not been identified. While it is not possible to accurately predict precise, future concentrations of PCBs in the water of the Hudson River at any particular location or time, it is my opinion that PCBs will be present and a threat to the plaintiff municipalities that use the Hudson River as a source of water.
3. Dredging in Phase 1 of the project has failed to remove all of the targeted mass of PCBs from the river for the dredged areas completed during Phase 1. Only one of the certification units, dredged in Phase 1 has successfully met the residual standard of 1 mg/kg TRI+ PCBs prior to closure. It is my opinion that even with re-dredging, it is unlikely that all of the certification units in Phase 2 will meet the residual standard for closure of the certification units.
4. It is my opinion that capping of residual PCBs in the closed certification units is only a temporary solution to the containment of residual PCBs. Resuspension of the river bottom sediments is inevitable and will result in the resuspension of PCBs in the water column and their transport downriver.
5. As demonstrated in Phase 1 of the project, concentrations of PCBs resuspended in the water column as a result of dredging in the Upper Hudson River vastly exceeded the acceptable load and concentration standards set by EPA and agreed to by GE. PCBs have been and continue to be resuspended and transported with the flow of water downstream, where they are redeposited in areas not planned for dredging. The locations of downstream deposition due to these releases are unpredictable due to fluctuations in the flow of the river. The quantity, concentration, and the effects of this deposition may not

be fully understood for many years, if not decades, to come. However, it is known that increased PCB water column concentrations have been recorded downriver, including during the dredging offseason and particularly, during high flow events in the river. These elevated PCB concentrations are likely to continue through the end of dredging and after dredging is completed. Therefore it is my opinion that alternative water supplies were required for the communities during dredging and will be required long after dredging is completed to minimize further exposure to PCBs.

6. The ongoing transport of PCBs in the form of resuspended sediments, dissolution in the water column, and surface transport as oil sheens, or as transport with the bed load of sediment in the river bottom, has exceeded the dredging project's engineering performance standards in both Phase 1 and Phase 2. It is my opinion that since the mass of PCBs transported in surface sheens and the bed load has not been quantified and the placement of redeposited PCBs has not been identified, future impacts due to these PCBs or the timing of the impacts from these PCBs, cannot be predicted with any level of certainty to permit the plaintiff municipalities to utilize the Hudson River as a safe source of drinking water supply not threatened by PCBs.
7. In my opinion, a stationary monitoring location collecting a time-weighted average sample will not capture the maximum concentrations of resuspended PCBs in the water column. Therefore, it is my opinion that stationary monitoring will not be adequate for predicting the concentrations of PCBs in the water at the intake to a public water supply with any level of surety.
8. The Engineering Performance Standards were designed to protect downstream public water supplies. By complying with the Engineering Performance Standards in Phase 1, EPA determined that the water from the Hudson River could be safely used as a source of water for the municipal water supplies. GE, however, was unable to consistently meet the Engineering Performance Standards during Phase 1. The revised Engineering Performance Standards developed for Phase 2 of the project have increased the allowable quantity of PCBs that can be released to the water column as a result of dredging, which poses an additional risk to the water supplies. It is my opinion that the higher mass loading and increased concentrations allowed under the Engineering Performance Standards in Phase 2, pose an additional risk to the water supplies of the plaintiff municipalities.
9. The well field for the Village of Stillwater is contaminated with PCBs with the same chemical signature as the PCBs in the Hudson River. In order to restore the well field for future use, it is my opinion that the PCBs in the aquifer materials of the Stillwater aquifer must be removed and the aquifer must be isolated from the river so that infiltration from the river cannot recontaminate the aquifer.
10. Due to the unknowns associated with ongoing sources of PCBs entering the river as well as the fate and transport of PCBs currently in the river, it is unrealistic to project the future concentrations of PCBs in the water column of the river with any certainty.

Further, it is impossible to predict the future concentrations of PCBs in the water supply sources connected to the river or the long term consequences of PCBs on the residents of the communities along the Hudson River with any level of confidence. Therefore, it is my opinion that even with the ongoing remediation, the time required to return the PCB concentrations in the river to levels before the start of dredging could take decades if not longer.

11. It is my opinion that until all of the PCBs already in the river and the sources of PCBs still entering the river have been identified and removed, including those in the well field at Stillwater, an alternative water source that is proven and reliable, must be available to the Village of Stillwater and the Towns of Waterford and Halfmoon to protect against the risk of unacceptable amounts of PCBs threatening the water supplies.
12. In my professional opinion, the only viable solution to ensure safe drinking water for the residents of Stillwater, Waterford, Halfmoon, and Saratoga County, is to provide a permanent, alternate source of water supply.

I reaffirm these opinions and offer responses to the opinions provided by the experts for the Defendant, General Electric Co.

4.0 Response to the Opinions of Neil Shifrin

4.1 General Electric Responsiveness to Environmental Concerns

In his expert report, Neil Shifrin described in great detail the efforts completed by GE to reduce and eliminate its discharge of PCBs to the Hudson River. Additionally, Dr. Shifrin provided commentary on the regulatory and customary industrial practices during the time of PCB usage by GE. While I do not doubt the validity of the actions on the part of GE, as described by Dr. Shifrin, I do have reasonable doubt concerning the motivations behind these actions and the timing of the results.

As indicated in his report, Dr. Shifrin stated,

> "Correspondingly, GE began measuring PCBs in its wastewaters at this same time in the early 1970s. Wastewater effluent monitoring data at Fort Edward indicate that process wastewater discharges of total PCB decreased from 20 lb/day in 1972 to 2.1 lb/day in mid-1975 to essentially zero in 1977 when PCB use was terminated in production processes. Hudson Falls plant process wastewater discharges decreased from 10 lb/day in 1972 to 0.2 lb/day in mid-1975 to zero after April 1977, when all plant wastewater was trucked to a new treatment plant at GE's Fort Edward plant."

> "GE used PCBs according to plant and corporate policies that considered PCB safety like any other industrial chemical until PCBs were identified as a potential environmental issue in 1967. Once so identified, GE quickly developed corporate policies and support to reduce PCB discharges to the environment, with many specific actions taken at the plants to achieve this goal."

While Dr. Shifrin extolls the virtues of GE's efforts to reduce its PCB waste disposal and paints the picture of GE as the benevolent corporate entity with respect to the environment, Dr. Shifrin failed to make mention of GE's Notices of Violations under the NYSDOH and NYSDEC. As a result, GE conducted much, if not all, of its "reasonable attempts and considerable progress to reduce its discharges of PCBs" (Shifrin, 2013) in response to the requirements of the State and in an attempt to minimize its financial liability with the State of New York. As Dr. Shifrin points out, GE needed ten years of study to identify the problem, propose viable solutions, and implement these actions to resolve their waste disposal issues. In my opinion, the ten year period from when PCBs were first identified as an environmental hazard until the elimination of PCB

discharge by GE in 1977, demonstrates a lack of regard by GE for the Hudson River and the residents that utilize the river as a source of drinking water.

Monsanto, the manufacturer of PCBs, directly notified GE and the electrical industry on February 18, 1970 of the hazards associated with PCBs. The letter sent out by Monsanto strongly recommended, “that all possible care should be taken in the application, processing and effluent disposal of these products to prevent them becoming environmental contaminants” (Olson, 1970). GE’s response to the Monsanto letter was to form a Task Force to study the effective control of waste Pyranol. However after a mere 3 months, the Task Force was presented with a list of specific recommendations regarding the control of Pyranol as initial efforts to be implemented with “more detailed and specific controls are expected to be necessary” (Murphy, 1970). As indicated in June 5, 1970 memo from Dr. K.R. Murphy to the Pyranol Task Force, one of the top priority control measures to be implemented was to have “all storage and loading areas constructed of impervious material and diked to contain spills and leakage” (Murphy, 1970). As related in Table D.1 of Dr. Shifrin’s report, paving and curbing around Pyranol transfer areas was completed between 1976 and 1977 (Shifrin, 2013). In my opinion, the time required to complete the control and containment measures in the storage and transfer locations of Pyranol showed a lack of commitment on the part of GE to environmental protection.

Further, the Electric and Nuclear Sub-Council of the National Industrial Pollution Control Council published a report in June 1971, advising the Electrical Industry to keep askarels, the electrical insulating liquids containing PCBs, from the environment by “limiting applications to closed systems… and by the exercise of suitable precautions in the disposition of waste”(NIPCC, 1971).

The Electric and Nuclear Sub-Council report further recommended,

1. “Provision is to be made for the qualified destruction of PCB waste materials, such that there will be no release of materials to the atmosphere or to ground or surface water significant to toxicity or adverse ecological impact. Initially, the only process

which appears to meet these requirements is incineration under carefully controlled conditions.

2. All liquid is to be held in impervious containers pending disposal.
3. Solid wastes contaminated by PCB's are to be held in impervious container pending disposal or purging. Purging may be accomplished by cleaning with proper fluids. The resulting contaminated liquids may be incinerated as above" (NIPCC, 1971).

General Electric was well aware of the hazards posed by PCBs and the recommendations advocated by the NIPCC. Fred J. Borch, chairman and chief executive officer of General Electric, was the vice-chairman of the Electric and Nuclear Sub-Council, which published the report. GE, however, continued its disposal of PCBs through its wastewater discharge rather than destroying these wastes through incineration. As detailed in his report, Dr. Shifrin stated that GE's wastewater discharges dramatically decreased from 30 lbs/day in 1972 to less than 0.002 lbs/day by 1977. Yet again, GE failed to follow its own recommendation and continued to pollute the Hudson River for an additional 6 years even after GE had advocated the disposal of PCB wastes through incineration.

Following the Monsanto announcement in 1970 and GE's acknowledgement of the hazards associated with PCBs by June 1971, GE made adjustments to its wastewater discharge from 1972 through 1975, which Dr. Shifrin described as "substantial reductions in wastewater PCB releases" (Shifrin, 2013). Other specific actions completed from 1972 through 1975 included the sealing of floor drains, drainage improvements and improvements to the wastewater treatment process (Shifrin, 2013). In my opinion, five years to implement these control measures was excessive, indicating a lack of responsiveness on behalf of GE to fix the problems that they had allowed to continue for decades.

With this knowledge and information, the question remaining was why did it take GE until April 1977 to eliminate all discharges of PCBs to the Hudson River? The answer to this question, I believe, was tied to the disposition of GE's notices of violations with the State of New York and the requirements of the pending Clean Water Act.

- On September 1, 1966, GE received official notification by the NYSDOH of violations of the Water Pollution Control Law and the requirements for pollution abatement. GE was required to change its treatment of wastewater prior to discharge to the Hudson River (GEWS-09105980).

- Following implementation of the Clean Water Act in 1972, GE was required to limit its discharge of contaminants to the Hudson River and monitor the levels of discharge (PLSEL-00031250, PLSEL-00029420).
- In 1974, GE was required to comply with the Spill Prevention and Containment Countermeasures requirements of the Clean Water Act (Shifrin, 2013).
- Regulatory and legal proceedings commenced against GE culminating in an Opinion and Order of September 8, 1976, which required GE to construct and operate a waste treatment and discharge control facility in addition to financial penalties (PLSEL-00336852).

Based on the start of the regulatory programs and the timing of the pollution control and reduction action completed by GE, the logical conclusion was that GE addressed the issues and took specific actions only when forced to respond by the EPA, the NYSDEC, and in response to pending legal action by the State of New York.

4.2 General Electric Use and Handling of PCBs

In the first opinion of his report, Dr. Shifrin described GE's use and handling of PCBs at its capacitor manufacturing plants. Dr. Shifrin stated,

> "For most of the decades of PCB use, GE manufactured PCB capacitors during a time when PCBs were viewed as safe for an industrial chemical, and there was no environmental issue about PCBs. During this time period, GE's use and handling of PCBs was consistent with good industrial practices for chemicals of this type. Once GE was alerted to the potential for PCBs to pose an environmental issue, it made all reasonable attempts, and considerable progress, to reduce its discharges of PCBs including a total termination of PCB use by 1977.
>
> GE's capacitor manufacturing released PCBs to the Hudson River from waste discharges and from inadvertent leaks and spills. …During the time they occurred, GE's discharges and leaks/spills were consistent with contemporaneous practices, regulations, and scientific knowledge, all of which are described below"(Shifrin, 2013).

Further, in his report, Dr. Shifrin stated,

> "Leaks and spills, common at most plants but never desirable nor predictable, were mainly viewed as nuisances or as an uneconomic loss of material, and were not viewed as a source of environmental contamination as they are today. Even as late as 1986, USEPA noted the limit of detection for leaks was about 1 gal/day"(Shifrin, 2013).

I agree with Dr. Shifrin in that leaks and spills were common at manufacturing facilities, especially during the time when GE used PCBs to manufacture transformers and capacitors. However, the loss rate of PCBs by the GE facilities was excessive, even when compared to the relatively lax standards cited by Dr. Shifrin.

When GE filed its application for an NPDES discharge permit in 1973, the amount of PCBs requested for discharge through treated wastewater was 30 lbs/day (PLSEL-00031250), approximately twice the acceptable loss rate for leaks and spills. This loss of PCBs through discharge of wastewater only accounted for losses from active manufacturing processes and did not include losses due to leaky tanks or transfer piping. An estimate of annual PCB loss was provided by Jerry Nelson in his report to J.F. McAllister in October 1969. As indicated in his report, Mr. Nelson estimated that the annual purchase of PCBs by the Power and Capacitor Department was approximately 10,000,000 lbs per year with a loss of PCBs as waste, of over 1,000,000 lbs per year (Nelson, 1969). Mr. Nelson's estimate was verified in 1970 by Dr. K.R. Murphy, who distributed a memo to the Pyranol Task Force stating that the estimated annual loss of PCBs as waste, was in excess of 1,500,000 lbs (Murphy, 1970). Based on the estimates of Nelson and Murphy, it is very clear that GE released large quantities of PCBs, in excess of 1,000,000 lbs, to the environment each year, which contributed to the contaminated sediments and water column concentrations in the Hudson River.

4.3 DNAPL and Contaminated Groundwater

Additionally, Dr. Shifrin advocates the idea that GE spills and leaks were inconsequential and that the small amounts lost through spills and leaks would not cause environmental concerns. In his report, Dr. Shifrin stated,

> "As with all factories handling fluids, there were many opportunities for leaks and spills at both Hudson plants. Without a cause-effect understanding of subsurface contamination and prior to the spill control regulations promulgated after the 1972 Clean Water Act, GE managed spills and leaks merely from a nuisance perspective. They had no understanding of the potential for PCB leaks and spills to cause environmental concerns" (Shifrin, 2013).

Further in his report, Dr. Shifrin described the accumulation of PCBs from capacitor manufacturing operations in the "Return Air Duct" beneath the capacitor manufacturing building. Dr. Shifrin stated,

> "In addition to likely storage/transfer leaks and spills, drippage during capacitor manufacturing was collected in floor drains, which fed to an outdoor cistern or to a collection pit in the "Return Air Duct" that was part of the air plenum air conditioning system, both of which released PCBs to the environment"(Shifrin, 2013).

From the "Return Air Duct", PCBs were released to the overburden soils where they entered the groundwater beneath the plant.

I strongly disagree with Dr. Shifrin in that GE did understand the potential for leaks and spills to cause environmental concerns. Dr. Shifrin fails to recognize that GE was the general contractor at the Pacific Northwest Laboratory in Hanford Washington from the late 1940's through 1969. As a part of their contract with the United States Atomic Energy Commission, GE was required to investigate and document the fate and transport of radionuclides from the soils at the Hanford site to the Columbia River. The project included the migration of contaminants through soils to the groundwater (Haney and Linderoth, 1959), the measurement and prediction of contaminant transport through the groundwater to the Columbia River (Raymond and Brown, 1963), and the impacts of the radioisotopes on the sediments in the river from the Hanford site to the Pacific Ocean (Nelson, et al., 1966; Perkins et al., 1966).

Beginning in the late 1950's, GE conducted a series of research projects at the Hanford site to determine groundwater flow characteristics in the overburden soils and bedrock at the site, and the transport of radioactive materials with the groundwater. As part of this research, GE developed numerical models to predict the flow of groundwater at the site as well as the transport of contaminants with the groundwater (Nelson, 1965). From this previous experience with the Hanford site, GE was intimately familiar with the transport of contaminants from soils to groundwater and from the groundwater into the river and river sediments.

4.4 Loss Rate

Furthermore, Dr. Shifrin described the leaks and spills at the GE facilities as inconsequential and an uneconomic loss. As stated in his report, Dr. Shifrin noted,

> "As noted above, the Hudson plants used many tanks, with undoubtedly thousands of feet of piping and many pumps to store and transfer PCBs. Spills and leaks of only 0.5% of the PCBs purchased would account for nearly 1 Million lb of PCBs in the environment. Surprisingly, only a few drops per minute from a small fraction of all this equipment could account for this large quantity of release. In an environment with leaks and spills occurring inadvertently throughout the plant, such a small leakage rate would not be noticeable and certainly would not be alarming unless there were catastrophic events, such as a tank rupture" (Shifrin, 2013).

In the footnote on pg. 31 of his report, Dr. Shifrin indicated,

> "For example, assume 25 years of operation (it was slightly longer) and a total of only 65 leaks throughout the system. If each such leak was 4 drops per minute at 0.1 mL/drop (about half the rate of a leaky bathroom faucet), it would release nearly 16,000 lb over the 25 years, or a total of 1 Million lb for all the leaks. This calculation shows how even a small amount of leakage could account for a sizeable total release; it is not suggested that this was the actual leakage rate. With dozens of tanks and pumps and with probably hundreds of transfer pipes, it is likely that there were more than 65 leaks at any given time throughout the plants, many of them underground, virtually all of which would easily have gone unnoticed" (Shifrin, 2013).

As Dr. Shifrin suggested, the leaks and spills associated with the tanks and piping at the GE facilities went relatively unnoticed. GE was not diligent in locating nor detecting leaks, including leaks in the above-ground and visible portions of the facility infrastructure, leading to the contamination of soils and groundwater beneath the facilities. After the PCBs migrated to the groundwater in the fractured bedrock, the same level of diligence exercised by GE allowed the buildup of PCBs within the Allen Mill.

With DNAPL present in the fractured bedrock below the Hudson Falls and Fort Edward facilities, the potential for migration of the DNAPL toward the river poses a threat to the Hudson River, especially since there are voluminous fractures, both above and below the water level in the river. If any of the DNAPL plume encounters a fracture leading to the river that is not captured by the groundwater containment system, there is a potential for release to the river. Using Dr. Shifrin's numbers for calculation (4 drops per minute at 0.1 mL/drop) and a density of

1.38 g/cm^3 (the density of Arochlor 1254), the amount of PCBs lost to the river from a single drip of DNAPL would be 795 g/day or 1.75 lbs/day. Five such leaks, spread across the entire surface of fractured bedrock, would release nearly 1.6 tons of PCBs to the river in one year. These inconsequential leaks would contribute PCBs that are more bioavailable with higher mobility than the aged PCBs in the river sediments. These freshly released PCBs will also have greater uptake in fish and a longer timeframe for migration out of the Upper Hudson River.

5.0 Response to the Opinions of John Connolly

5.1 Sources of PCBs Entering the Hudson River

In his report, Dr. John Connolly, stated that remedial controls have been effective at the GE facilities and that because of these controls, the Fort Edward and Hudson Falls plant sites are not a significant source of PCBs to the Upper Hudson River (Connolly, 2013). Further, Dr. Connolly stated,

> **"**Dr. Brown offers the opinion in Section 4.2 of his report that the PCB sources at the GE Hudson Falls and Fort Edward Plants have not been fully quantified and, therefore, should be considered to be potentially significant despite extensive remediation at both GE facilities (Brown 2013). This opinion does not take into account the Hudson River water column data, which demonstrate the effectiveness of the measures that GE has implemented to control PCB migration to the river" (Connolly, 2013)

In support of his contention, Dr. Connolly cites the NYSDEC

> "Source control at the plant sites (cessation of direct untreated discharges, implementation of numerous IRMs by GE, and implementation of the final remedies at both plants by GE and NYSDEC) has created a new status quo – the plant sites no longer appear to be sources of PCB to the river of large scale significance." (NYSDEC 2012)

as support that PCBs from the plants are not significant sources of PCBs currently entering the Hudson River and do not continue to contribute to the PCB mass in the river. However, Dr. Connolly does not provide reference for what he means by the term "significant". Nor does Dr. Connolly account for overland transport of contaminated soils (stormwater runoff) or discharge of contaminated groundwater and DNAPL from the fractured bedrock seeps beneath the plants that are not captured by the groundwater containment systems. Further, as Dr. Connolly quotes "the plant sites no longer appear to be sources of PCB to the river of large scale significance", but as of yet, have not been confirmed with any scientific certainty to have minimized their contribution to the River much less eliminated as a source of PCBs to the river. Therefore, it is my opinion that both the Hudson Falls and Fort Edward plant sites continue to be potential sources of PCBs entering the Hudson River.

5.2 Presence of Pools of PCB DNAPL

In his report, Dr. Connolly indicated that intensive sampling of the river has failed to indicate a significant pool of PCB DNAPL within or under the sediments in the dredging areas of the Hudson River. Dr. Connolly stated,

> **"**If a significant pool of PCB DNAPL was present within the sediments, it would have been found" (Connolly, 2013).

In response to Dr. Connolly's contention that DNAPLs were not present in the sediments, I note that NAPLs were observed on numerous occasions during Phase I dredging (Connolly, 2012; Gibson Exhibit 12; Gibson Exhibit 19) and during the installation of sheet piling (Gibson Exhibit 22). As a result of sheen formation on the surface of the river, the dredging procedures were modified for Phase II to account for the presence of sheens (Parsons, 2011) and a special study was designed to investigate the characteristics and conditions related to the formation of sheens as a result of dredging (Louis Berger, 2010).

Further, as Dr. Connolly has failed to define the term "significant" in relation to the size of the pool or quantity of DNAPL that could be present within the sediment, he has discounted the instances when sheens have formed as a result of dredging, coring, or sheet pile installation. The fact that no "significant" pools of DNAPL have been found does not mean that a pool of DNAPL is not present, only that a pool of unspecified size or quantity has not been found to this point in the dredging project. Further, there is a possibility that a pool of this nature could be located outside of the designated dredging areas. Therefore, it is my opinion that pools of DNAPL have been encountered during previous dredging operations and could potentially be found in areas remaining to be dredged.

5.3 Residual Concentrations

In the third opinion of his report, Dr. Connolly stated that the dredging operations have removed

> "nearly all the PCBs in the targeted areas. In general, the PCB concentrations left behind are low and the residual coring indicates sediments that have less than 1 mg/kg Total PCBs exist below the residual sediments" (Connolly, 2013).

Dr. Connolly further stated,

> "Although there are isolated locations where post-dredging PCB concentrations are greater than 1 mg/kg Total PCBs in the sub-surface sediments, the distribution of these samples indicate limited sub-surface contamination is present. … Furthermore, the remaining PCBs are buried under backfill and cap material, which isolates them from the river" (Connolly, 2013).

However, Dr. Connolly did not indicate what residual mass remains within the closed certification units. Likewise, he did not specify how many isolated locations remain or where and how much limited sub-surface contamination remains.

The questions left unanswered are how well sequestered are the residual PCBs and how permanent will the cap be? The Hudson River is a dynamic body that is continually cutting and wearing away the surface at the bottom of the riverbed. Due to the variability in the flow and velocity of the river, predicting the erosion of the river bed and cap is uncertain. Because of this uncertainty, the resuspension and downstream migration of the residual PCBs will always be a threat.

5.4 Impacts of Redeposited Sediments

Dr. Connolly has previously admitted that dredging resuspends sediment and this resuspended sediment will be deposited or remain in suspension to travel downstream. In his report however, Dr. Connolly stated that data collected during Phase II of the project, indicated that the resuspended sediments do not have a long-term impact on the Upper Hudson River. As supporting evidence, Dr. Connolly cites the Downstream Deposition Studies conducted in 2011,

2012, and 2013, from which samples were collected before and after dredging. As indicated by Dr. Connolly,

> "Total and Tri+ PCB concentrations measured in DDS samples were generally lower than those measured in 2002 to 2005" (Connolly, 2013).

Additional evidence that redeposition of dredged sediment did not have a long-term effect on the Upper Hudson River was based on data collected during periods when no dredging was occurring upstream of the Thompson Island monitoring station.

According to Dr. Connolly, water concentrations at Thompson Island returned to pre-dredging levels within six to eight months after dredging in 2009 and the absence of impact was observed in 2013. Although I do not dispute the data presented by Dr. Connolly, I question the conclusions he presents.

For example, in his deposition of 2012, Dr. Connolly testified, "Based upon dredging experience at other sites, I think there was considerable information about resuspension occurring during dredging" and "At the time the dredging on the Fox River had been a pilot scale program and it showed the release of significant amounts of PCB during the dredging operation and difficulty at that time in getting to a clean surface" (Connolly, 2012). Further, in his deposition, Dr. Connolly stated, "When we were seeing significant resuspension in the river we implemented sampling further away from the dredge to get a better understanding of the fate of the PCB's that were being resuspended as they migrated from the dredge to the first far field station" (Connolly, 2012).

Clearly, dredging resuspends sediments. If the resuspended sediments are not redeposited within the same unit as the dredging operation, then the sediments must be transported to another location or transported out of the section of the river entirely. As indicated in his opinion, Dr. Connolly stated that the potential transport and deposition of the resuspended sediments depends "on particle size, the local characteristics of the river channel, and the flow conditions" (Connolly, 2013). During the Downstream Deposition Studies conducted during Phase II of the

dredging project, it is likely that the sediments were transported beyond the dredged area and deposited undetected in areas downstream of the dredge.

Additionally, Dr. Connolly stated that concentrations at Thompson Island decreased quickly following the completion of dredging and began to approach background concentrations. However, the concentrations in the water column at stations downstream continue to spike during high flow events, confirming that the freshly deposited sediments are highly mobile and readily available for transport.

5.5 Engineered Capping of Sediments

In his report, Dr. Connolly stated that capping of residual sediments provides a viable means to prevent the migration of PCBs in the water column. As Dr. Connolly indicated, in situ capping has been implemented at numerous sites across the country as a means to stabilize the residual sediments. However, EPA and the U. S. Army Corps of Engineers have yet to complete any extended-time studies related to the stability of the engineered cap. Since PCBs have a very long life-time in the environment, any engineered cap must maintain its integrity to prevent further resuspension and transport of PCBs.

Further, Dr. Connolly stated,

> "In the Hudson River, engineered caps are designed to act as a barrier that both isolates and stabilizes the residual sediment" and "a detailed cap design analysis was performed for the targeted dredge areas as part of the 2011 Final Design Report" (Connolly, 2013).

My concern with respect to the cap is based on the integrity of the capping materials and whether they can withstand the powerfully erosive forces of the river. Water in the river will find a way to flow over, under, and around any aggregate used as a surface layer of the cap. Once the aggregate is displaced, the underlying finer-grained materials can be easily eroded, exposing the residual sediments and PCBs. As an example, the high flow event in 2011 produced limited damage to the capped areas from Phase I. With slight to moderate disturbance of the cap caused by one high flow event, the durability of the cap remains questionable.

5.6 GE Groundwater Plumes as a Source of PCBs to the Hudson River

Dr. Connolly opines that the contaminated groundwater plumes at the GE Hudson Falls and Fort Edward facilities are not a source of PCBs to the Hudson River. As a basis of his opinion, Dr. Connolly relies on a September 27, 2012 update by the NYSDEC to the Hudson River Community Advisory Group, which claimed that "the plant sites no longer appear to be sources of PCB to the river of large scale significance" (Connolly, 2013). I disagree with Dr. Connolly's position in this matter. While remedial actions at the two GE sites have reasonably contained the contaminated groundwater from leaving the site and minimized the contributions to the Hudson River, the groundwater capture and control system at the GE facilities have not eliminated the release of PCBs to the groundwater. Thus, the groundwater plumes continue to contribute PCBs to the Hudson River.

Dr. Connolly also critiques my opinion that dredging will increase the flow of groundwater in the river. As briefly discussed in my previous report, DNAPL under the Hudson Falls facility has migrated downward through the Snake Hill Shale into the fractured zone of the upper portion of the Glens Falls Limestone. The DNAPL and dissolved-phase PCB plumes under GE site and extending west below the Hudson River have migrated down gradient to the southeast and currently extend downstream under the Hudson River. The upward gradient of groundwater from the underlying Glens Falls Limestone and Isle La Motte Limestone towards the Snake Hill Shale and the Hudson River has brought dissolved phase PCBs from the underlying DNAPL and contaminant plume into the top layer of the aquifer and the Hudson River (NYSDEC, 2004).

According to the ROD, the Glens Falls Limestone has a vertical gradient upward, but the horizontal flow gradient is to the south, down the axis of the Hudson River valley, which if uncontrolled, likely would result in groundwater discharge into the Hudson River some distance south of the site" (NYSDEC, 2004). With the foregoing groundwater flow scenario, DNAPL and the dissolved phase PCB plume in the Snake Hill Shale may discharge directly into Hudson River south of the GE facility and above the Thompson Island Dam. DNAPL and dissolved PCB

plume from the Glens Falls Limestone may discharge into the Hudson River south of the Stillwater Dam.

Based on fundamental hydrologic principles, the removal of sediments from the Hudson River may increase the exchange between surface water and the underlying bedrock aquifers. The sediments in the bottom of the river act as a semi-permeable, hydraulic barrier to the flow of water between the river and the groundwater. By removing the sediments, the hydraulic conductivity of the geologic materials overlying the aquifer may increase, allowing more water to flow into and out of the groundwater-bearing zone. With increased groundwater flow, the migration of DNAPL and dissolved-phase PCB plumes in the bedrock may be enhanced and may flow to the valley of the river. For sediments in the Thompson Island pool, the increased infiltration of water above the dam may lead to an upflow of contaminated groundwater at some point downstream of the dam.

5.7 Transport of PCBs with the Bedload Sediments

In his report, Dr. Connolly claimed that "there is no mass of PCB-contaminated bedload sediment or a DNAPL plume/pool moving along the river bottom," undetected by the water column monitoring system. Dr. Connolly further stated that GE continues to operate a state-of-the-art monitoring system, designed to provide the most representative water samples as can reasonably be achieved. According to Dr. Connolly, water samples collected to date have not identified any DNAPL in the sediment, and the presence of pools of DNAPL cannot be supported.

I disagree with Dr. Connolly in that DNAPLs, if present in the sediments, would not be collected in the water samples collected in the monitoring system. In my previous report, I detailed the drawbacks of GE's monitoring system including the inability of a stationary monitor to capture sheens containing PCBs at the surface of the water or PCBs adsorbed to sediments moving downriver with the bed load as well as the uncertainty of the sample collection corresponding to the location of the monitor within the channel.

Further, Dr. Connolly claimed that the series of locks and dams in the Upper Hudson River, prevent the flow of DNAPL and bedload sediments downstream. Again, I disagree with Dr. Connolly. Highly contaminated sediments below the dam contain PCBs at concentrations that are greater than the concentrations possible by partitioning from the water column.

5.8 Declining Water Column Concentrations following Dredging

In Opinion 8 of his report, Dr. Connolly stated that "PCB levels in the river decline rapidly in response to the dredging program" (Connolly, 2013). In support of his opinion, Dr. Connolly cites the water column data for the Thompson Island pool and the trend in the data from before dredging and after dredging. Further conclusions presented by Dr. Connolly include:

- "Increases in flow rate no longer cause significant increases in PCB concentrations downstream of dredged areas (Figure 4-3); which is consistent with low residual concentrations in remediated areas.
- PCB concentrations measured at the background buoy during a high flow event between June 10 and June 17 and then again between June 28 and July 11, 2013, were below the MDL (Figure 4-4). Non-detect PCBs at high flow conditions are consistent with low residual concentrations in remediated areas.
- PCB concentrations at Thompson Island decreased rapidly after dredging moved downstream of the TIP (Figure 4-5), and approached concentrations measured at the background buoy.
- In 2010, (Appendix C, Figure C-1e) when no sediment removal from the Hudson River was conducted, PCB concentrations at Thompson Island were consistent with pre-dredging (BMP) conditions, indicating that residual sediment in areas downstream of the areas dredged did not contribute a significant amount of PCBs to the river. This indicates that dredging does not result in long-term increases in PCB concentrations" (Connolly, 2013).

I do not question the validity of the data presented by Dr. Connolly. However, the decreasing trend observed in the data for the Thompson Island pool was not observed in the data for the samples collected at Lock 5, Stillwater and Waterford. In my analysis of the water column data, there was no significant change in the concentrations at Lock 5, Stillwater and Waterford since 2009, but dredging is not complete. As the dredging locations move closer to the towns, I would expect to see higher concentrations in general with frequent upsets in the water column data.

Further, concentrations in the water column remain elevated during the annual high flow event indicating that there are high residual concentrations remaining in the area upstream of the towns.

5.9 Projections of Water Column Concentrations

In his report, Dr. Connolly opines that GE can predict with reasonable accuracy that the concentrations of PCBs will not increase over the pre-dredging concentrations after dredging is complete. But contrary to his opinion, Dr. Connolly stated, "While uncertainties exist, they do not preclude the use of reliable models along with our general knowledge of the system to predict what will happen in the future. … Although it is true that the models do not take account for redeposition, as discussed previously, that phenomenon has been found to have only a short-term effect on water column PCB concentrations" (Connolly, 2013).

As Dr. Connolly stated, there are many uncertainties that limit the usefulness of the model prediction. As indicated in my previous report, after dredging, it is still unknown what total mass of PCBs will remain in the sediments and where these sediments have been redistributed. Further, it is still unknown as to what concentrations the PCBs in the river will increase during high flow events in the river and where the contaminated sediments will be deposited during flood events.

6.0 Response to the Opinions of Stephen Johnson

6.1 Appropriate Regulatory Levels

In his report, Stephen Johnson discussed the different regulatory levels applicable to the Water from the Hudson River. The regulatory levels presented by Mr. Johnson included:

1. "The first standard is a PCB concentration of 500 nanograms per liter ("ng/l" or "parts per trillion" ["ppt"]), which represents the maximum concentration of polychlorinated biphenyls ("PCBs") that may be present in a public drinking water supply system. … Provided the PCB concentration in a drinking distribution system is at or below the Maximum Contaminant Level ("MCL") of 500 ng/l, the water purveyor is not obligated to take action to reduce the PCB concentration.
2. "The second standard is a PCB concentration of 90 ng/l. In contrast to the MCL, the 90 ng/l figure was established pursuant to the federal Clean Water Act and the New York Environmental Conservation Law. … Unlike MCLs, water quality standards themselves generally are not enforceable. Rather, they are used as target concentrations for various purposes, which can include the development of enforceable discharge standards."

I agree with Mr. Johnson that both of the applicable standards apply to the water in the Hudson River. However, Mr. Johnson has overlooked two very important regulatory levels. In setting Standards for Safe Drinking Water, EPA states that for carcinogens, "if there is evidence that a chemical may cause cancer, and there is no dose below which the chemical is considered safe, EPA has set the Maximum Contaminant Level Goal (MCLG) at zero; i.e., no amount of PCBs are considered acceptable. However, for chemicals like PCBs that are believed to cause cancer, EPA has set an enforceable stand called a Maximum Contaminant Level (MCL). MCLs are set as close to the MCLGs as possible, considering the ability of public water systems to detect and remove contaminants using suitable treatment technologies.

In the development of its Risk-Based Concentrations (RBCs), EPA Region III has developed a set of equations to calculate the risk-based concentration for PCBs via water ingestion. The risk-based concentration for PCBs in tap water is 34 ng/L at a cancer risk level of one in a million (EPA, 2013). According to the Risk Based Concentration Table the MCL for PCBs is listed as 500 ng/L for only the Low Risk PCBs. The MCL for PCBs was set at 500 ng/l, because EPA

believes given present technology and resources, this is the lowest level to which water systems can reasonably be required to remove this contaminant should it occur in drinking water."

The ingestion uptake slope factor (SL) at a carcinogenic target risk of 1 in a million for those same Low Risk PCBs, is 170 ng/L. As a comparison, the ingestion SL for Arochlor 1248 and Arochlor 1254 is 34 ng/L. Thus for PCBs, which are known carcinogens, the MCL of 500 ng/L and the water quality standard of 90 ng/L are not protective of human health at the foregoing risk based concentrations.

6.2 Use of Granular Activated Carbon

As stated in his report, Mr. Johnson agreed with the EPA selection of granular activated carbon (GAC) for treatment of the water at Stillwater and powdered activated carbon (PAC) for the water treatment plants at Halfmoon and Waterford. The GAC filtration system was to be used continuously at Stillwater during Phase I dredging while the PAC filtration system was an interim system for use until the completion of the water supply line with the City of Troy.

I was not in favor with the decision to use activated carbon as the treatment process for drinking water. First and foremost, the backwash from the activated carbon treatment specified in GE's Water Supply Options Analysis (2007) would have exceeded the NYS water quality standard of 90 ng/L. The Water Treatment Plants for each of the towns could not dispose of the backwash into the River and would have to arrange for alternate disposal of wash water or saturated carbon. The loss of readily available disposal effectively eliminates flushing and maintenance activities for reuse of the powdered activated carbon in the PAC system of the Waterford and Halfmoon Water Treatment Plants. (Added expense for disposal and handling costs)

When added to the other drawbacks of using activated carbon such as

- Tunneling and breakthrough of PCB contaminants;
- Inefficient adsorption of PCBs by carbon;
- Loss of particulate solids through the filter; and
- Additional manpower, testing and energy costs to ensure continued operation,

It is my opinion that the most reliable water supply option with the least add-on cost and maintenance was the connection to the water supply at the City of Troy. In my opinion, the towns made a reasonable judgement to move to a permanent alternate water supply.

6.3 Waterford and Halfmoon Actions to Obtain Water

In Mr. Johnson's opinion, the contingent supply of alternative water for the Waterford and Halfmoon water treatment plants did not appear to pose an imminent or unacceptable threat. As stated by Mr. Johnson,

> "As noted in Section 6.0 of this report, the 2002 ROD did not identify the protection of drinking water supplies as a basis for the remedy EPA selected to address the presence of PCB's in the Hudson River. … To address this concern, EPA evaluated the potential risks to the water supplies posed by dredging, developed a contingency measure to protect the water supplies, and crafted the EPA Decision Criteria to identify when implementation of the contingency measure would be appropriate" (Johnson, 2013)

From the 2009 Community Health and Safety Plan (CHASP), "EPA's Water Supply Decision Criteria for triggering this contingency during Phase 1 are measurement of a concentration equal to or exceeding the Resuspension Standard of 500 ng/L Total PCBs at any far-field monitoring station (i.e., Thompson Island, Schuylerville, Stillwater, or Waterford) or at any Upper Hudson River water supply system or if there is insufficient time (taking into account time-of-travel considerations) to provide at least 4 hours advance notification to these water suppliers prior to the arrival of a potentially contaminated parcel of water at the Halfmoon and Waterford water supply intakes. These water suppliers will be notified by EPA when these contingency measures may be needed" (GE CHASP, 2009).

After the criteria for contingent water were triggered, Waterford and Halfmoon would remain on the alternative water source. "Once levels return below the Resuspension Standard of 500 ng/L Total PCBs, the Waterford and Halfmoon water suppliers will be notified by EPA that the contingency measures can be relaxed or removed. This will be based on the actual monitoring data while also taking into account any time-of-travel considerations. Typically, contingency measures may be deactivated as soon as the results from two consecutive days of sampling yield no sample with a PCB concentration equal to or above 500 ng/L."(GE CHASP, 2009)

EPA's Water Supply Decision Criteria for triggering the contingency measures were based on the water column monitoring in the River. As specified in my previous report, the deficiencies in GE's monitoring plan were numerous including variable concentration across the river channel and anisotropic mixing with depth in the water column. When coupled with the lack of reproducibility between samples from the automated collectors and manually collected samples, there was no certainty that the water column concentrations were truly representative of the concentrations in the water entering the water supply intakes.

Further, "since a composite sample is essentially a time-weighted sample, composite sampling will not provide information on temporal conditions or short-term spikes in concentration of the water column. Composite samples will not guarantee that representative concentrations of PCBs in the water are measured."(Brown, 2013) Likewise, stationary monitoring locations add additional uncertainty to the actual concentrations of PCBs resuspended from dredging. With the uncertainty associated with sample collections, the validity and representativeness of the water column concentrations triggering the contingency measures are highly suspect.

6.4 Criteria for National Contingency Plan

Mr. Johnson's report stated that the NCP uses four governing factors to assess whether a response action is relevant and appropriate:

> "The EPA Removal Guidance describes various CERCLA and NCP factors governing removal actions. In addition, the guidance lists four factors to use to determine whether to use removal or remedial authorities for a response:
>
> 1. Time-sensitivity of the response (need to take relatively prompt action),
> 2. The complexity of the problems and the action,
> 3. The comprehensiveness of the proposed action, and
> 4. The likely cost of the action."

Further, Mr. Johnson stated,

> "The NCP requires a remedial investigation ("RI") to characterize the nature of a hazardous substance contamination problem and the threat posed by it. *See* 40 CFR 300.430(d). The characterization must include collection of information to develop and evaluate remedial action alternatives. The remedial investigation must include the

> collection of information to perform another element of an RI: a baseline risk assessment that characterizes the current and potential threats to human health and the environment. The party performing the RI must also identify requirements that are applicable or relevant and appropriate ("ARAR") to the contaminants and location."

I disagree with Mr. Johnson and believe that the responsibility for completing these particular elements lies with GE. As the responsible party, GE was obligated to conduct an appropriate RI which addressed the impacts of elevated water concentrations on the drinking water supplies of the towns, including a baseline risk assessment for the towns' residents and a formal feasibility study/remedial action alternatives assessment. The residents of the towns should not be responsible for paying the cost of the RI and the feasibility study in addition to the higher cost of water. Since GE failed to fulfill its obligation, the towns were justified in seeking an alternate source of drinking water. Mr. Johnson also ignores the fact that EPA endorsed the response actions taken by the municpalities to connect to alternative water sources. The Modified Consent Decree and CHASP provided for the construction of the Troy pipeline and payment of alternative water costs for Waterford and Halfmoon. Similarly, EPA implemented in Stillwater a Temporary GAC system pending the construction of a pipeline to the Saratoga County Water Authority, who like Halfmoon and Waterford secured an alternative source of water on the Hudson River not impacted by PCBs. Moreover, under the CHASP, GE was to contribute to the payment of the Stillwater pipeline. The response actions taken by municipalities to obtain alternative sources of water were consistent with NCP and endorsed by state and federal regulatory officials.

6.5 Restoration of the Stillwater Aquifer

In Section 10.1 of his report, Mr. Johnson opined that an appropriate solution to the contamination of the Stillwater aquifer does not require the restoration of the aquifer to a pristine state. As stated by Mr. Johnson,

> "Dr. Brown states that in order to restore the Stillwater well field for future use, PCBs in the aquifer materials must be removed through excavation and backfill of aquifer materials, and the aquifer must be isolated from the river to prevent recontamination of the aquifer."

Mr. Johnson also stated that my opinion ignored the basic concepts of the response action process and was based on unfounded assumptions and incomplete information and analyses. As Mr. Johnson further stated,

> "In fact, an appropriate solution to contamination of water supplies does not necessarily require restoration of an aquifer to a pristine state. Dr. Brown's opinion also ignores what Stillwater has done in response to the contamination of the well field. Given that Stillwater no longer relies on the well field, it is not clear that any response action is needed, much less one as extreme as what Dr. Brown proposes."

In response to Mr. Johnson's argument, I am aware of the requirements of the NCP and understand the need for a complete evaluation of the conditions, including an analysis of potential alternatives. However, Mr. Johnson's point begs the question as to who is responsible for all of the additional assessment and who is ultimately responsible for implementing the remedial actions needed.

GE has the obligation to complete the analysis and any further assessment needed. In my opinion, GE also has the obligation as the responsible party to restore the aquifer, not to the pristine condition as designated by Mr. Johnson, but to the original condition prior to GE's release of PCBs to the environment.

6.6 Restoration of the Stillwater Aquifer

In Section 10.2 of his report, Mr. Johnson responded that my opinion is extreme and contrary to his experience in the theory and practice of environmental protection. Mr. Johnson also stated his belief that the remedial actions that I proposed to clean up the Stillwater aquifer are excessive and not possible.

I would like to point out the geological conditions of the Stillwater aquifer to Mr. Johnson. The Stillwater aquifer was formed on the inner curve of the Hudson River with sediments, both coarse and fine-grained, deposited over time. The well field is constructed on a point bar of the Hudson River and is underlain by approximately 30 feet of water-bearing sand and gravel that coarsens with depth. The water bearing zone is overlain by fine grained flood plain sediment

(Malcolm Pirnie, 2009). The water-bearing zone consists of a coarse sand to a depth of approximately 28 feet below ground surface. The aquifer has been classified by the NYSDOH as Groundwater Under the Direct Influence (GWUDI) of Surface Water (Malcolm Pirnie, 2009). Recharge from the Hudson River to the well field has led to the infiltration and transport of PCBs into the well field and contamination of the aquifer soils. The PCBs within the aquifer soils have similar chemical fingerprints as the PCBs released from the GE plants, based on the congener analysis and homologue patterns of the aquifer soils and groundwater samples (Malcolm Pirnie, 2009).

With respect to the remedy proposed in my previous report, PCBs infiltrating the aquifer from the river must be cut off and the PCB mass contained in the aquifer matrix must be removed. The installation of a non-permeable barrier which can segregate the aquifer from the river, must precede any remedial action to remove the residual PCBs in the aquifer. The residual PCBs in the aquifer soils are recalcitrant and cannot be chemically treated or effectively flushed from the aquifer soils. Additionally, natural attenuation of the aquifer is not a viable option because of the longevity of PCBs in the environment. The remedy proposed is very similar in scope to the excavation and removal of PCB contaminated soils and sediments, completed by GE at OU 4 at the Fort Edward facility.

6.7 Safe Source of Drinking Water

In his report, Mr. Johnson stated that Opinion 12 in my report suffers from several flaws and is simply not relevant to many of the residents of Saratoga County. As Mr. Johnson points out, many of the residents in Saratoga County do not rely on water from the Hudson River as a source of drinking water. However, many of these residents are exposed to PCBs on a daily basis through the air they breathe. While I admit that a formal risk assessment has not been done for the residents of Saratoga County, the responsibility and obligation to complete the risk assessment and the remedial investigation rests with GE.

7.0 Response to the Opinions of Scott Warner

7.1 Groundwater Flow

In the report of Scott Warner, Mr. Warner opined on the groundwater flow at the Stillwater aquifer based his interpretation of site information presented by other, unreferenced sources and his experience in interpreting groundwater flow conditions for numerous environments. His opinion was given without basis except for his experience.

7.2 Hydraulic Barrier Wells

In Section 4.1.1.2 of his report, Mr. Warner proposed to create a hydraulic barrier using the contaminated wells to isolate the non-impacted wells from the river. In my opinion, this scenario will create two problems. First, the additional pumping of the aquifer will cause a lowering of the water table leading to additional infiltration of PCB contaminated water from the river. Secondly, by pumping the contaminated wells, a large quantity of contaminated water will be generated, which must be disposed.

APPENDIX 1

Documents Relied Upon for the Preparation of this Report

Documents Relied Upon for the Preparation of this Report

GEAUT-00199808. Discharge Permit, 1980. New York State Department of Environmental Conservation State Pollutant Discharge Eliminations System (SPDES). April 3, 1980.

GEAUT-0277239. Permit to Discharge, 1974. National-Pollutant Discharge Elimination System. December 20, 1974.

GEAUT-00322180 – GEAUT-00322283. Hudson River PCB DNAPL Transport Study. June 1997.

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